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Hyperbolic angular momentum

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Abstract: In this work we investigate the structure of angular momentum through the oscillator realization introduced by Schwinger, in which the generators of the $su(2)$ algebra arise from pairs of harmonic oscillator ladder operators. Within this framework an additional set of operators appears naturally which satisfies the $su(1,1)$ algebra, a structure which Schwinger refers to as hyperbolic angular momentum. We first present a graphical visualization of the Schwinger oscillator basis that clarifies and illustrates the action of both the standard angular momentum ladder operators and the hyperbolic operators. In this picture the usual $su(2)$ ladder operators move within a fixed irreducible representation of angular momentum, while the $su(1,1)$ ladder operators move between these irreducible representations of angular momentum and within a fixed irreducible representation of hyperbolic angular momentum. As an application of this structure, we present Schwinger's algebraic derivation of the allowed values of the total angular momentum in the coupling of two spin systems, obtaining the bounds without appealing to the usual dimension-counting argument.

Biography: Jackson Lewis is a second year M.S. student in mathematics and physics at SIU. Before that, he received a B.S. in mathematics from Austin Peay State University in Clarksville, TN. At SIU, Jackson's research falls into the broad area of mathematical physics, focusing on algebraic studies of quantum mechanics and representation theory. Jackson is also the founder of the SIU Quantum Gravity Group, where faculty and students of the math and physics departments meet to discuss the mathematics and physics relevant to the covariant formulation of Loop Quantum Gravity.